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Tiedekunta-Fakultet-Faculty
Valtiotieteellinen tiedekunta

Laitos-Institution-Department
Department of Statistics

Tekijä-Författare-Author
Niemi, Aki

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Tiivistelmä-Referat-Abstract
Statistical methodology for forest regeneration monitoring is presented. The objectives are to construct spatial point process models for saplings, and to develop theory for model-based sampling from these processes.

The main components affecting the early-stage spatial pattern of saplings are site-preparation (soil treatment) and regeneration method. The effect of site-preparation is predominant. First, planting and sowing take place in the treated tracks. Second, the density of naturally regenerated saplings is higher within the tracks than outside.

The RACS driven Cox process, a new class of spatial point processes, enables one to model the spatial pattern of site-preparation tracks and to incorporate a higher sapling density inside the tracks than outside. In this hierarchical model, the distribution of site-preparation tracks is modelled by a random closed set (RACS).

The classical theory of spatial sampling deals with estimation of the mean value of a realisation of a stationary, continuous-parameter random field. This theory utilises the covariance function of the random field, assuming that it is monotonically decreasing and positive definite.

In forest regeneration monitoring, the estimation of the sapling density is performed by plot sampling where the number of saplings is counted from sample plots placed in the regeneration area. The statistical problem is that the classical sampling theory is not directly applicable.

The problem is solved via a transformation from the observation of a stationary point process, to a stationary continuous-parameter random field. Further, the covariance function of the resulting random field is derived. The formula is a function of the intensity and the pair correlation function of the point process, and the size of the sample plot.

In the empirical part, two RACS driven Cox process models are constructed according to authoritative instructions on site-preparation. One model is for a mounded regeneration area and another for a disc trenched area. Comparison with data shows that the models describe reasonably well the spatial pattern of the saplings.

References:

Matern, B. (1960). Spatial variation. Meddelanden fran Statens Skogsforskningsinstitut 49(5).

Stoyan, D. & Kendall, W. S. & Mecke, J. (1995). Stochastic Geometry and Its Applications, 2nd edition. Wiley, Chichester.

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